

REMARKS

Claims 27-31 having been previously canceled, Claims 1-27 are now presented for examination. Claims 1, 6, 10, 15, 19 and 24 are the only independent claims.

Claims 1-5, 10-14 and 19-23 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,288,772 to Shinozaki et al. in view of U.S. Patent No. 5,412,214 to Suzuki et al. This rejection is respectfully traversed.

Pending independent Claims 1, 10 and 19 are directed to projection exposure apparatus using a mask that includes plural columns of a mask pattern for repeated exposure to a member to from plural columns of an exposure pattern thereon. In the apparatus, an illumination system irradiates light to the mask. A projection system projects the light from the mask onto the member. An exposure stage moves the member and a mask stage moves the mask. A controller controls light irradiation from the illumination system to the mask, drives the exposure stage and drives the mask stage. The controller alternately performs the light irradiation and step driving of the exposure stage to move the member by an amount equal to n times the pitch of the columns of the exposure pattern. The controller performs step driving of the mask stage to move the mask by a movement amount equal to n times the pitch of the columns of the mask pattern in association with step driving of the exposure stage in an early phase and a later phase of the repeated exposure where n is a natural number smaller than the number of columns of the mask pattern.

In Applicants' view, Shinozaki et al. discloses a scanning exposure arrangement in which a mask and a substrate are moved in a synchronous manner. The first patterns and a second pattern are connectedly exposed on the substrate. At least a portion of the first patterns and at

least a portion of the second pattern form a common pattern, and the common pattern and non-common patterns, which differ from the common pattern, are formed in a mask as the first patterns and the second pattern. The first patterns and the second pattern are connected by means of the common pattern.

In Applicants' opinion, Suzuki et al. discloses a projection exposure arrangement which can perform a focusing operation with respect to a partly omitted shot exposed at a peripheral portion of a photosensitive substrate such as a wafer. In the projection exposure arrangement, when a prohibition band having a predetermined width is set from the edge of the substrate, and exposure is to be performed with respect to a shot area having a portion located only within the prohibition band and the remaining portion located outside the edge of the substrate, a focus detection point is shifted to the boundary line of the prohibition band on the substrate, and a focusing operation is performed. Thereafter, the focus detection point is moved to an original target shot exposure position to perform exposure.

According to the invention defined in Claims 1, 10 and 19, the step driving of the mask stage moves the mask by a movement amount equal to n times the pitch of the columns of the mask pattern in association with the step drive of the exposure stage in the early and later phases of the repeated exposure, where n is a natural number smaller than the number of columns of the mask pattern. Advantageously, the whole area corresponding to each column of the exposure pattern is exposed and then each column is formed through the plural light irradiations of the plural exposure processes and the exposure in the early and later phases is as appropriate as in the intermediate phase..

It is a feature of Claims 1, 10 and 19 that a controller alternately performs light irradiation and step driving of an exposure stage to move a member an amount equal to n times the pitch of the columns of the exposure system. Shinazaki et al. discloses exposing a member by an exposure arrangement wherein the substrate is moved in a stepwise manner but does not teach or suggest controlling by the alternate light irradiation and exposure stage step driving as in the present invention. In Shinazaki et al., the movement distance PS1 is the spacing between adjoining image fields and is unrelated to the pitch of columns as in Claims 1, 10 and 19. It is a further feature of Claims 1, 10 and 19 that the mask is moved in step manner an amount of n times the pitch of the columns of the mask pattern in association with the step movement of the substrate in the early phase and the later phase of repeated exposure. It is not seen that Shinazaki et al. provides any suggestion of repeated exposure of the early and later phases so that the exposure amount in the early and later phases is the same as the exposure in the other phase.

Suzuki et al. may teach projection exposure apparatus with a step and repeat process but does not in any manner teach or suggest alternate light irradiation and step driving of an exposure stage as in Claims 1, 10 and 19 wherein the columns are repeatedly exposed to light irradiation as directed by a controller. Accordingly, it is not seen that the addition of Suzuki et al.'s step and repeat without any suggestion of alternate irradiation and step driving for repeated exposure to Shinazaki et al.'s exposure arrangement without control of alternate light irradiation and stage step driving moving the mask pattern in association with the substrate step movement in early and later phases of repeated exposure could possibly suggest the features of Claims 1, 10 and 19. It is therefore believed that Claims 1, 10 and 19 are completely distinguished from any combination of Shinazaki et al. and Suzuki et al. and are allowable.

Claims 6-9, 15-18 and 24-27 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over the Shinozaki et al. patent in view of the Suzuki et al. patent and U.S. Patent No. 6,597,002 to Kondo. This rejection is respectfully traversed.

Pending independent Claims 6, 15 and 24 are directed to projection exposure arrangements using a mask that includes plural columns of a mask pattern for repeated exposure to a member to form plural column of a mask pattern thereon. In the apparatus, an illumination system irradiates light onto the mask. A projection system projects the light from the illumination system onto the member. An exposure stage moves the member. A light shielding member stage shields light to prevent light projection onto the member from some of the plural column of the mask pattern. A light shielding member stage moves the light shielding member. A controller controls light irradiation from the illumination system to the mask, driving the exposure stage and driving the light shielding member stage. The controller alternately performs the light irradiation and step driving of the exposure stage to move the member by a movement amount of n times the pitch of the columns of the exposure pattern. The controller performs step driving of the light shielding member stage to move the light shielding member by an amount corresponding to a pitch of n columns of the mask pattern in a light projection region on the member in association with step driving of the exposure stage in the early phase and the later phase of the repeated exposure where n is a natural number smaller than the number of the columns of the mask pattern.

In Applicants' view, Kondo discloses a device that drives movable blades which set an illumination area on a reticle composed of linear motors so that vibration due to eccentricity will not occur as opposed to the conventional rotary motor. This eliminates one of the major causes

of vibration of the device, resulting in improved accuracy on exposure. Since the linear motors drive the blades in the direction corresponding to the synchronous movement of the reticle and the wafer, the linear motors do not cause vibration when the blades move at a constant speed. Therefore, even if the thrust of the linear motors is increased with requirements of a higher reticle stage performance, vibration is not generated during synchronous movement of the reticle and the wafer, thereby improving the synchronous speed, and as a result the throughput.

In accordance with the invention of Claims 6, 15 and 24, a controller in a projection exposure apparatus alternately performs light irradiation and step driving of an exposure stage to move a member by a movement amount of n times the pitch of the columns of the exposure pattern and the controller performs step driving of a light shielding member stage to move the light shielding member by an amount corresponding to a pitch of n columns of the mask pattern in a light projection region on the member in association with step driving of the exposure stage in the early phase and the later phase of the repeated exposure where n is a natural number smaller than the number of the columns of the mask pattern.

As discussed with respect to Claims 1, 10 and 19, Shinazaki et al. only teaches movement of a substrate by the spacing between adjoining image fields but does not in any manner suggest alternate light irradiation and movement related to the pitch of columns of an exposure pattern. Further, it is not seen that Shinazaki et al. in any way suggests the feature of driving a light shielding member stage to move the light shielding member by an amount corresponding to a pitch of n columns of the mask pattern in a light projection region on the member in association with step driving of the exposure stage in the early phase and the later phase of the repeated exposure where n is a natural number smaller than the number of the

columns of the mask pattern so that so that the exposure amount in the early and later phases is the same as the exposure in the other phase.

Suzuki et al. is restricted to teaching projection exposure apparatus with a step and repeat process but fails to suggest in any manner alternate light irradiation and step driving of an exposure stage wherein the columns are repeatedly exposed to light irradiation and the repeated exposure of early and later phases through use of a light shield directed by a controller to provide the same exposure in the early and later phases as in the other phase. Kondo may teach a light shielding member made up of two movable blades BL1 and BL2 which as shown in Figs. 1 and 2 define a rectangular opening for illumination light that will impinge on the reticle to set a slit shaped illumination area of preferred size and shape on the reticle. Kondo, however, is devoid of any suggestion of the movable blades forming a light shielding member which shields light to prevent light projection onto a member from some of plural columns of a mask pattern and is controlled in movement amount of a pitch equal to n columns of a mask pattern in a light projection region in association with step driving of an exposure stage in early and later phases of repeated exposure as in Claims 6, 15 and 24.

Accordingly, it is not seen that the addition of Kondo's light shielding blades defining a rectangular area illumination light for a reticle and Suzuki et al.'s step and repeat process devoid of the controlled movement for early and later phases of repeated exposure to Shinazaki et al.'s movement of a substrate by the spacing between adjoining image fields without any suggestion of alternate light irradiation and movement related to the pitch of columns of an exposure pattern or controlled exposure of early and later phases in repeated exposures could possibly suggest the features of Claims 6, 15 and 24.. It is therefore believed that Claims 6, 15 and 24 are completely

distinguished from the any combination of Shinazaki et al., Suzuki et al. and Kondo and are allowable.

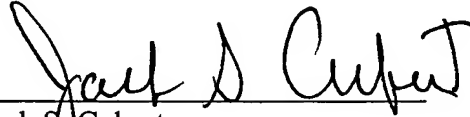
For the foregoing reasons, Applicants submit that the present invention, as recited in independent claims 1, 6, 10, 15, 19 and 24, is patentably defined over the cited art, whether that art is taken individually or in combination.

Dependent claims 2-5, 7-9, 11-14, 16-18, 20-23 and 25-27 also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in their respective independent claims. Further individual consideration of the dependent claims is requested.

Applicants further submit that the instant application is in condition for allowance. Favorable reconsideration, withdrawal of the objection and rejections set forth in the above-noted Office Action, and an early Notice of Allowance are requested.

Applicants' attorney, Steven E. Warner, may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our address listed below.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Jack S. Cubert", written over a horizontal line.

Jack S. Cubert
Attorney for Applicants
Registration No. 24,245

FITZPATRICK, CELLA, HARPER & SCINTO
30 Rockefeller Plaza
New York, New York 10112-3800
Facsimile: (212) 218-2200
JSC/eab